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HOW TO GET STRONG.

IN MIDDLE AND ADVANCED LIFE.

IN the last few papers we have considered, with a purpose, how fat may most effectively and at the same time most advantageously be reduced. Our reason has been that several correspondents, not claiming to be entitled to become members of the Fat Men's Club, but still too fat for comfort, have asked whether there is any way in which they can participate without discomfort in exercises which they supposed meant only for those in good condition. It will be seen on a careful reading of our remarks upon their requirements that nearly everything recommended for them is good also for those who are not in the least troubled with obesity, nay even for those who are positively lean. Our suggestions for reducing weight are nearly all in reality suggestions for increasing flesh. A great deal of fat may in the case of the corpulent be removed while little flesh is put on, and so the weight may be greatly reduced; but it is almost impossible to follow any sound regimen for reducing fat without adding flesh. Indeed testing methods for reducing fat by merely weighing is not satisfactory. Taking two corpulent men of equal weight and equally fat, one shall by potions, unwholesome food, undue sweating (without exercise) and in kindred ways, take twenty-five pounds off his weight in a month; while the other will in the same time by healthy exercise, cold bathing, and attention to the points touched on in preceding papers, lose no more perhaps than some five or six pounds; yet the former shall feel weaker and more oppressed by his weight than before, while the other will be altogether heartier and more vigorous, lighter and more active, than he had been. In one case perhaps some twenty pounds of fat and some five pounds of flesh have been lost: in the other, some ten pounds of fat only may have been lost while five pounds or so of flesh have been added. It is not difficult to see which of the two has gained most by his fat-reducing efforts; or rather one has gained all round, while the other though twenty or twenty-five pounds lighter is a much weaker man than before he lost the weight.

When we consider the effect of one and the other process on inferior organs such as the heart and lungs, &c., we see still more clearly the superiority of a system by which while fat is reduced flesh is increased. The fat man's heart for instance is not only overloaded with fat, but the heart-muscle is weaker than it should be: to reduce or even remove the fat by a process which at the same time weakens the muscle, is to do at least as much harm as good,—probably more. But a regimen which gradually removes the fat, while increasing not only the quantity but the quality of the muscle, is good all round. In the long run such regimen leads to the more complete and permanent reduction of fat also. For the man who has simply wasted is not in a fit state to resist the return of fat which begins so soon as the wasting process has ceased. He is far more likely to be simply prostrate during the enemy's approach and unable to prevent it from re-occupying all the positions whence it had been expelled. On the other hand the wiser regimen gives vigour to circulation, respiration, and digestion, increases strength of will and purpose, and makes the attack on such undue deposits of fat as may remain not only effective but pleasant work. And the good habits by which this result has been obtained are not likely afterwards to be dropped,—at least, to be dropped long enough to allow undue obesity to return.

But other correspondents ask whether in middle and advanced life either the regimen or the special exercises which we recommend for the increase of strength or (where necessary) for the reduction of weight, can be pursued. We answer unhesitatingly that they can, due regard being had to such moderation as experience and common sense alike enjoin.

As an introduction to the remarks we propose to make on this part of our subject, we quote a letter from a man who was eminent for literary ability and business capacity, who lived a full life as well as a long life, and who wrote what we are about to quote at the age of seventy-seven:—

"I promised some time since," wrote the poet Bryant to a friend in 1871, "to give you some account of my habits of life, so far at least as regards diet, exercise, and occupations. I am not sure that it will be of any use to you, although the system which I have for many years observed seems to answer my purpose very well. I have reached a pretty advanced period of life without the usual infirmities of old age, and with my strength, activity, and bodily faculties generally in pretty good preservation. How far this may be the effect of my way of life, adopted long ago, and steadily adhered to, is perhaps uncertain.

"I rise early; at this time of the year about half-past five; in summer, half an hour or even an hour earlier. Immediately, with very little encumbrance of clothing, I begin a series of exercises, for the most part designed to expand the chest, and at the same time call into action all the muscles and articulations of the body. These are performed with dumb-bells (the very lightest, covered with flannel), with a pole, a horizontal bar, and a light chair swung around my head. After a full hour, and sometimes more, passed in this manner, I bathe from head to foot. When at my place in the country I sometimes shorten my exercises in the chamber, and going out, occupy myself for half an hour or more in some work which requires brisk exercise. After my bath, if breakfast be not ready, I sit down to my studies till I am called. . . . . After breakfast I occupy myself for awhile with my studies, and then, when in town, I walk down to the office of the *Evening Post*, nearly three miles distant, and, after about three hours, return, always walking, whatever be the weather or the state of the streets. In the country I am engaged in my literary tasks till a feeling of weariness drives me out into the open air, and I go upon my farm or into the garden and prune the fruit-trees, or perform some other work about them which they need, and then go back to my books. I do not often drive out, preferring to walk."

Seven years later, soon after Bryant's death at the age of eighty-four years, Mr. William G. Boggs, who knew the poet intimately for many years, gave the following reminiscences to a representative of the *Evening Post*:—

"During the forty years that I have known him Mr. Bryant has never been ill—never been confined to his bed, except on the

occasion of his last accident. His health has always been good. Mr. Bryant was a great walker. In earlier years he would think nothing of walking to Paterson Falls and back, with Alfred Pell and James Lawson, after office hours. He always walked from his home to his place of business, even in his eighty-fourth year. At first he wouldn't ride in the elevator. He would never wait for it, if it was not ready for the ascent immediately on his arrival in the building. Of gymnastic exercises he was very fond. Every morning, for half an hour, he would go through a series of evolutions on the backs of two chairs, placed side by side. He would hang on the door of his bedroom, pulling himself up and down an indefinite number of times. He would skirmish around the apartment after all fashions, and once he told me even "under the table." Breakfast followed, then a walk down town; and then he was in the best of spirits for the writing of his editorial article for that day. . . . . He was a constant student. His daily leading editorial constituted, and was for many years, the *Evening Post*. Sometimes he would not get it written until one o'clock. 'Can't I have it earlier?' I asked him one day. 'Why not write it the evening before?' 'Ah,' he replied, 'If I should empty out the keg in that way, it would soon be exhausted.' He wanted his evenings for study. 'Well, then, can't you get down earlier in the morning?' He said, 'Oh yes.' A few months afterwards he exclaimed, with reference to the change: 'I like it.' I go through my gymnastics, walk all the way down, and when I get here I feel like work. I like it.'"

Mr. Boggs also stated that Mr. Bryant's sight and hearing were scarcely impaired even up to his death.

(To be continued.)

THE BIRTH AND GROWTH OF MYTH.

By Edward Clodd.

XV.

IN addition to the beliefs in the transformation of men into animals and in the transmigration of souls into the bodies of animals, we find among barbarous peoples a belief which is probably the parent of one and certainly nearly related to both, namely, in descent from the animal or plant, more often the former, whose name they bear. Its connection with transmigration is seen in the belief of the Moquis, an Indian tribe, that after death they live in the form of their totemic animal, those of the Deer family becoming deer, and so on through the several clans. The belief survives in its most primitive and vivid forms among two races, the aborigines of Australia and the North American Indians. The word "totemism," given to it both in its religious and social aspects, is derived from the Algonquin "dodaim" or "dodhaim," meaning "clan-mark." Among the Australians, the word "kobong," meaning "friend" or "protector," is the generic term for the animal or plant by which they are known. It is akin in significance to the Indian words "manitou," "oki," &c., comprehending "the manifestations of the unseen world, yet conveying no sense of personal unity," which are commonly translated by the misleading word "medicine;" hence, "medicine-men."

The family name, or second name borne by all the tribes in lineal descent, and which corresponds to our surname, *i.e.*, *super nomen*, or "over-name," is derived from names of beasts, birds, &c., around which traditions of their transformation into men linger. Sir Geo. Grey* says that there is a mysterious connection between a native and his kobong. It is his protecting angel, like the "daimon" of Socrates, like the "genius" of the early Italian. "If it is an animal, he will not kill one of the species to which it belongs, should he find it asleep, and he always kills it reluctantly and never without affording it a chance of escape. The family belief is that some one individual of the species is their dearest friend, to kill whom would be a great crime," as, in Hindu belief, when a Rajah was said to have entered at death into the body of a fish, a "close time" was at once decreed. Among the Indian tribes we find well-nigh the whole fauna represented, their totem being the Bear, Turtle, Deer, Hawk, Eagle, Pike, Buffalo, &c. Like the Australians, these tribes regarded themselves as being of the breed of their particular animal-totem, and avoided hunting, slaying and eating (of which more presently) the creature under whose form the ancestor was thought to be manifest. The Chippeways carried their respect even further. Deriving their origin from the dog, they at one time refrained from employing their supposed canine ancestors in dragging their sledges. The Bechuana and other people of South Africa will avoid eating their tribe-animal or wearing its skin. The same prohibitions are found among tribes in Northern Asia, and the Vogulitzi of Siberia, when they have killed a bear, address it formally, maintaining "that the blame is to be laid on the arrows and iron, which were made and forged by the Russians!" Among the Delawares the Tortoise gens claimed supremacy over the others, because their ancestor, who had become a fabled monster in their mythology, bore their world on his back. The Californian Indians are in interesting agreement with Lord Monboddo when, in claiming descent from the prairie wolf, they account for the loss of their tails by the habit of sitting, which, in course of time, wore them down to the stump! The Kickapoos say their ancestors had tails, and that when they lost them the "impudent fox sent every morning to ask how their tails were, and the bear shook his fat sides at the joke." The Patagonians are said to have a number of animal deities, creators of the several tribes, some being of the caste of the guanaco, others of the ostrich, &c. In short, the group of beliefs and practices found among races in the lower stages of culture point to a widespread common attitude towards the mystery of life around them. In speaking of totemism among the Red Races, Dr. Brinton thinks that the free use of animate symbols to express abstract ideas, which he finds so frequent, is the source of a confusion which has led to their claiming literal descent from wild beasts. But the barbaric mind bristles with contradictions and mutually destructive conceptions; nothing is too wonderful, too *bizarre* for its acceptance, and the belief in actual animal descent is not the most remarkable or far-fetched among the articles of its creed.

The subject of totemism is full of interest both on its religious and social side:—

On its religious side it has given rise, or, if this be not conceded, impetus, to that worship of animals which assuredly had its source in the attribution of mysterious power through some spirit within them, making them deity incarnate.

On its social side it has led to prohibitions which are inwoven among the customs and prejudices of civilised communities. But, before speaking of these prohibitions, the barbaric mode of reckoning descent should be noticed.

The family name borne by any Australian tribe is perpetuated by the children, whether boys or girls, taking their mother's name. Precisely the same custom is found among the American Indians—the children of both sexes being of the mother's clan. Now, the family, as we define it, does not exist in savage communities, nor, as Mr. McLennan says in his very remarkable work on "Primitive Marriage," had "the earliest human groups any idea of kinship, . . . the physical root of which could be discerned only through observation and reflection." Where the relations of the sexes were confused and promiscuous, the oldest system in which the idea of blood-ties was expressed

* "Travels in N.W. and W. Australia," Vol. II., 229.

was a system of kinship through the mother. The habits of the "much-married" primitive men made mistake about any one's mother less likely than mistake about his father; and, if in civilised times it is, as the saying goes, a wise child that knows its own father, he was, in barbarous times, a wise father who knew his own child. Examples tracing the kinship through females, father and offspring being never of the same clan, abound in both ancient and modern authorities, and perhaps the most amusing one that can be given is found in Dr. Morgan's "Systems of Consanguinity." He says that the "natives of the province of Keang-se are celebrated among the natives of the other Chinese provinces for the mode, or form, used by them in address, namely, 'Laon peaon,' which, freely translated, means, 'Oh, you old fellow, brother mine by some of the ramifications of female relationship!'"

The prohibitions arising out of totemism are two: 1. Against intermarriage between those of the same name or crest. 2. Against the eating of the totem by any member of the tribe called after it.

1. Among both Australians and Indians a man is forbidden to marry in his own clan, *i.e.*, any woman of his own surname or badge, no matter where she was born or however distantly related to him.

Were this practice of "Exogamy," as marriage outside the tribe is called, limited to one or two places, it might be classed among exceptional local customs based on a tradition, say, of some heated blood-feud between the tribes. But its prevalence among savage or semi-savage races all the world over points to reasons the nature of which is still a *crux* to the anthropologists. The late Mr. McLennan, whose opinion on such a matter is entitled to the most weight, connects it with the custom of female infanticide, which, rendering women scarce, led at once to polyandry, or one female to several males, within the tribe, and to the capturing of women from other tribes. This last-named practice strengthens Mr. McLennan's theory. He cites numerous instances from past and present barbarous races, and traces its embodiment in formal code until we come to the mock relics of the custom in modern times—as, for example, that harmless "survival" in bride-lifting, that is, stealing, as in the word "cattle-lifting."

Connected with this custom is the equally prevailing one which forbids intercourse between relations, as especially between a couple and their fathers and mothers-in-law, and which also forbids mentioning their names. (I have, by the way, heard more than one cynical son-in-law express regret that certain features of this custom had not survived among ourselves.) So far as the aversion which the savage has to telling his own name, or uttering that of any person (especially the dead), or thing feared by him is concerned, the reason is not far to seek. It lies in that confusion between names and things which marks all primitive thinking. The savage, who shrinks from having his likeness taken in the fear that a part of himself is being carried away thereby, regards his name as something through which he may be harmed. So he will use all sorts of roundabout phrases to avoid saying it, and even change it that he may elude his foes, and puzzle or cheat Death when he comes to look for him. But why a son-in-law should not see the face of his mother-in-law, for so it is among the Aranaks of South America, the Caribs and other tribes of more northern regions, the Fijians, Sumatrans, Dayaks, the natives of Australia, the Zulus, in brief, along the range of the lower culture, is a question to which no satisfactory answer has been given, and to which reference is here made because of its connection with totemism.

II. That the animal which is the totem of the tribe should not be eaten, even where men did not hesitate to eat their fellows, is a custom for which it is less hard to account. The division of flesh into two classes of forbidden and permitted, of clean and unclean, with the resulting artificial liking or repulsion for food which custom arising out of that division has brought about, is probably referable to old beliefs in the inherent sacredness of certain animals. The Indians of Charlotte Island never eat crows, because they believe in crow-ancestors, and they smear themselves with black paint in memory of that tradition; the Dacotahs would neither kill nor eat their totems, and if necessity compels these and like barbarians to break the law, the meal is preceded by profuse apologies and religious ceremonies over the slain. The abstention of the Brahmins from meat, the pseudo-revealed injunction to the Hebrews against certain flesh-foods (that against pork has its origin, it has been suggested, in the tradition of descent from a boar) need no detailing here. But, as parallels, some restrictions amongst the ancient dwellers in these islands are of value. It was, according to Cæsar,* a crime to eat the domestic fowl, or goose, or hare, and to this day the last-named is an object of disgust in certain parts of Russia and Brittany. The oldest Welsh laws contain several allusions to the magical character of the hare, which was thought to change its sex every month or year, and to be the companion of the witches, who often assumed its shape.† The revulsion against horseflesh as food may have its origin in the sacredness of the white horses, which, as Tacitus remarks,‡ were kept by the Germans at the public cost in groves holy to the gods, whose secrets they knew, and whose decrees regarding mortals their neighings interpreted. That this animal was a clan-totem among our forefathers there can be no doubt, and the proofs are with us in the white horses carved in outline on the chalk hills of Berkshire and the west, as in the names and crests of clan descendants.

The survival of the totem in heraldry is worth more than a passing remark, and will have further reference in a succeeding chapter.

PRETTY PROOFS OF THE EARTH'S ROTUNDITY.§

CHIEFLY FOR THE SEASIDE.

By Richard A. Proctor.

(*Continued from page* 140.)

NEARLY every one must have noticed that when you are in an inland road near the sea, at a considerable height above the sea-level, you are apt when you get a sudden view of the sea-horizon to find it much higher than you had expected. This is particularly the case if there are steep side-tracks leading down towards the sea from the road you are following and if you have had reason to note the steepness and depth of these side-tracks as you advance, without however seeing the sea itself for some time. Then when you come upon an opening leading to the sea, you look *down* for the sea-horizon and find that you must turn your eyes upwards to see it: not upwards in reality, nay

* "De Bell. Gall.," V., c. 12.

† Elton's "Origins of English History," p. 297.

‡ Germania, IX., 10.

§ I beg to state that those are entirely mistaken who imagine that these papers are intended for the benefit or instruction of the flat earth paradoxers. They are meant entirely for those who know the earth to be a globe, but (like myself) take interest in noting simple proofs of the fact.

XUM

in reality somewhat though not perceptibly downwards, but upwards from the direction in which you had first looked expecting to see the horizon.

This is by many regarded rather as a difficulty than as a proof of the earth's rotundity. Yet no one can look at the sharply defined sea-horizon as seen from a considerable height, under favourable atmospheric conditions, without seeing at once that that sharpness of definition is inconsistent with flatness. When far beyond the sea-horizon land is in view, the contrast between the distinctness of the sea-horizon and the indistinct hazy look of the land beyond affords another striking evidence of the rotundity of the sea-surface, for it shows that there is more haze between the eye and the land than there is between the eye and the part of the sea-surface where the sea-horizon line is formed.

effective. I have never known any one who has ever tried it under good observing conditions without finding that strong though his faith might already have been in the rotundity of the earth, it was much confirmed and strengthened by this particular observation. It makes the observer *feel* as it were that the sea surface rises in a bold sweep between him and the more distant object seen in the same field of view.

But this way of recognising the sea's rotundity may be improved upon. Let us suppose that our observer starts from A, to climb up the cliff (along the roadway will do very well) till, after passing the level a, he reaches the summit of the cliff at a'.

When he is at A the line of sight to the sea-horizon meets the sea curve close by as at p and the clearness of the sea-line, supposing the observation made in good observing

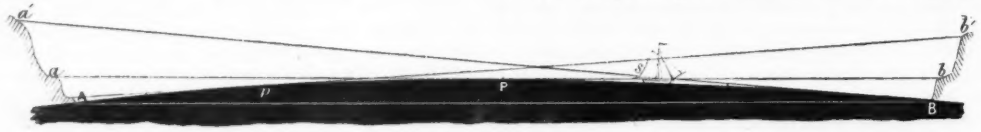

Fig. 15.

Thus if a (Fig. 15) be the place of an observer, A the sea-level beneath him, and a P b the line of sight touching the sea-horizon at P, and extending onwards to the cliffs at b, we are not merely convinced but feel instantly that P is much nearer than b, when we find that the sea-horizon at P is seen much more clearly than the cliffs at b. We know then that the surface must round itself above the straight line A B in order to have this relative nearness at P.

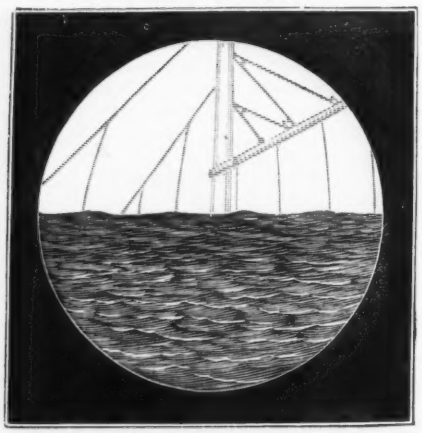

Fig. 16.

But an even prettier proof of the rotundity of the water-surface may be obtained by using a powerful telescope at a station such as a, and directing it upon the horizon-line at P towards a ship as at s. It will be found that when the telescope is focussed so as to show the sea-horizon distinctly, the masts and sails of the ship s are seen indistinctly. Fig. 16 gives an idea of what is seen. To bring the ship sharply into view, the focussing rack-work must be used so as to carry in the eye-tube, as for a more distant object, and then presently the parts of the rigging in view are seen sharply defined as in Fig. 17, while the sea-horizon has become hazy and indistinct. Where a low magnifying power is employed on a large telescope, so that the focal range for different distances is relatively great, this observation is singularly

weather, is very striking, as is also the contrast between the sharp definition of the sea surface at p and the haziness of the cliff at b' if that is visible at all, as of a ship at s. If the telescope is used as in the experiment just described, at such a station as A, the amount of focussing required to correct from a clear sea-horizon into well defined ship rigging, or *vice versâ*, is much greater than when the telescope is set higher above the sea-level.

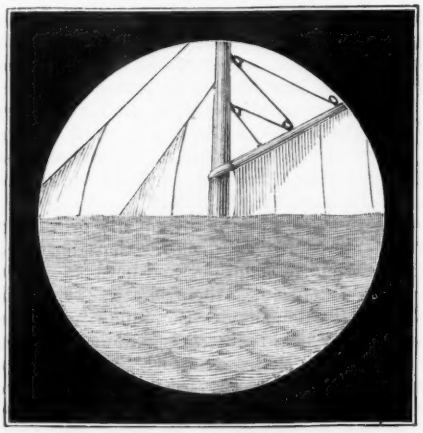

Fig. 17.

When the observer has reached a, the sea-horizon has retreated to P, and is less distinctly seen, though it is very marked against the distant cliff at b. But when, passing onwards to a', he brings the sea-horizon to B or even further from him, so that he sees to the very foot of the cliff, then the sea-horizon (on either side of the cliff B b b' (which we suppose to be a cape projecting towards him) is no longer seen to be freer from the effects of haze that the cliff's face at b. If the observer has noted the sea-horizon from time to time during his ascent he will have seen (presuming the weather remains tolerably constant) that the sea-horizon gets lighter and lighter in tone as he passes higher and higher, showing that it passes farther and farther away and is thus more and more affected by the presence of any haze that may be in the air

For even in the clearest weather there is always enough haze near the sea-level to affect the distinctness of the sea-horizon, when, owing to the observer's ascent, it is thrown twenty or thirty miles away.

(To be continued.)

THE FISHERIES EXHIBITION.

By JOHN ERNEST ADY.

VI.

LET us now look a little higher in the scale of sponge life. We find sponges which strongly resemble the simple *Ascetta** already described; they go a step further to form the family *Leucones*, of which *Leucon* (Fig. 13, D) is a type. The advance in structural complexity consists in this,—that the ectoderm or syncytium becomes greatly thickened, and, as a consequence, the simple pores which

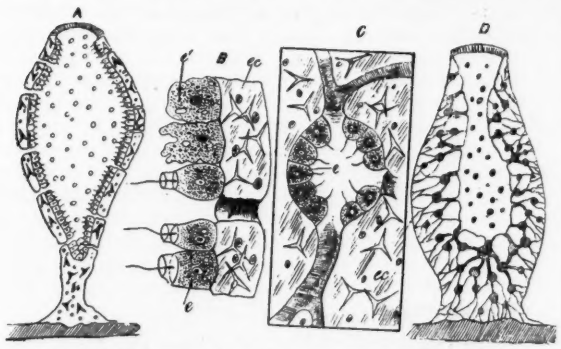

Fig. 13.—Diagrams to show the structure of ASCONES and LEUCONES. A, *Ascetta primordialis*, one of the ASCONES. B, Portion of the body-wall of the same highly magnified to show *e c*, ectodermal syncytium with spicules; *e*, flagellate cells of endoderm; *e'*, endodermal cells without flagella; *p*, an inhalent pore. D, *Leucon*, to show greatly thickened syncytium with branched anastomosing canals, and ciliated chambers. C, One of the ciliated chambers of *Leucon* highly magnified; *e c*, the syncytium; *e*, endodermal cells of ciliated chamber.

lead into the body cavity of *Ascetta* (which is typical of its family, the *Ascones*) are here converted into long tubes, which may branch, and unite at intervals. The endodermal ciliated cells, moreover, do not now form a continuous layer lining the body cavity, but are parcelled out into groups which everywhere stud dilatations in the branching tubes. These dilatations are known as the *ciliated chambers* (Fig. 13, C; Fig. 14, *c*) or *ciliated baskets* of the sponge, and are the representatives of the once continuous endoderm.

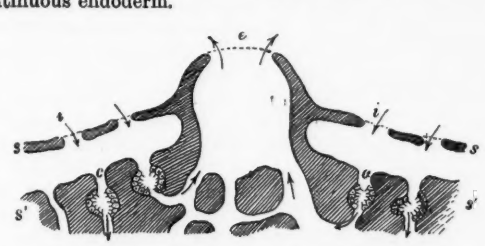

Fig. 14.—Hypothetical section of a *Spongilla*. *s*, superficial layer; *s'*, deeper substance of sponge; *i*, inhalent apertures; *e*, exhalent aperture; *c*, ciliated chambers. The arrows indicate the direction of the currents. (After Huxley.)

* *Ut supra*, p. 124.

In *Spongilla fluviatilis*, the common fresh-water sponge, a growth something like that which has just been noted is developed as shown in Fig. 14, but with this difference, that in place of the calcareous spicules of the *Leucones* there is a fibrous skeleton of keratose strengthened with spicules of silica, which are also scattered amongst the sponge-cells, or *sarcoids*, as the latter are sometimes called. In the curious *Halisarca* we have a sponge identically similar, but entirely devoid of a skeleton; it has therefore been placed in a division by itself, the *Myxospongiæ*. In the sponges of commerce also (*Spongia*), the main difference lies in the nature of the skeleton, which is wholly fibrous and composed of keratose. The beautiful siliceous sponges, *Euplectella* and its allies, are likewise all resolvable into the type of structure which has now been explained.

There is one peculiar process which we have before alluded to as an aberrant phase in the life-history of *Spongilla* to which we would now draw attention, as of importance to those who desire to follow its interesting details practically.* During the autumnal months several contiguous cells in the body of the sponge lose their ordinary appearances, and acquire bright granules, which finally obscure their other characteristics. The cells immediately surrounding the group so formed, unite to produce a kind of coat for them, and secrete in this a skeleton of keratose. Each central cell now develops a peculiar siliceous spicule, resembling two toothed-wheels united by an axle (Fig. 15). A small opening, or *hilum*, is left at one

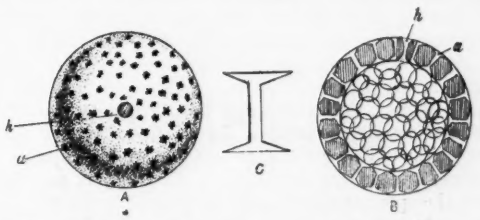

Fig. 15.—*Spongilla fluviatilis*.—A, so-called "seed" or "gemmule," external aspect showing hilum, *h*, and toothed tops of spicules or amphidiscs. B, diagrammatic section of gemmule, showing position of amphidiscs, *a*; *h*, hilum. C, amphidisc seen in profile (after Nicholson).

part of this *amphidiscus*; its protoplasm dwindles away till nothing but the outer keratose coat and the peculiar spicules, arranged perpendicularly to the surface, as in Fig. 15, remains. This condition is arrived at in winter, and the bodies, now known as *sponge seeds*, remain thus during the cold months. On the advent of spring, however, the internal cells resume their activity, are extruded from the hilum, and settle down to develop into a young *Spongilla*.

Lastly, there is a genus of sponges which bore into the shells of molluscs by means of curiously-shaped siliceous spicules, and live there parasitically; these *Clionidæ* have been found in some of the oldest geological formations, *e.g.*, from the Silurian upwards. Their anatomy, and therefore their affinities, has not yet been determined.

We cannot here enter into the details of the arguments respecting the affinities of the sponges. Suffice it to say, that the weighty evidence of the formation of a blastoderm, and its subsequent passages through the morula, gastrula, and other stages, is sufficient to place the group of sponges (*Porifera*) nearer the *Cœlenterata* than the *Protozoa*. This will become apparent when we have defined what a cœlenterate animal is; but, to avoid confusion, we must

* *Spongillæ* may be obtained from Mr. G. H. King, 165, Great Portland-street, W.; or from Mr. Thomas Bolton, of 57, Newhall-street, Birmingham, both of whom have shown specimens at their stands in the Exhibition.—J. E. A.

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not anticipate matters here. We may merely remark that the presence of *thread-cells* detected by Eimer* in certain sponges (*Renieridæ*) helps largely to support these conclusions.

Before we leave the subject of the sponges let us look a little more in detail at one of the beautiful siliceous forms (*Euplectella*), which finds so deservedly attractive a place in the Exhibition buildings. The first specimen of this sponge was brought to this country from the Philippines for the Zoological Society, and was carefully described with figures by the distinguished Director of the British Museum in the "Transactions" of that Society.† Dr. Owen supposed that the upper broad end was buried in the sea bottom, and that the smaller extremity, with its tuft of fibres, was its upper free portion. It is now known that the reverse of this is actually the case, and that the fibrous narrow extremity anchors the sponge to the substratum. In Lady Brassey's case there are also a few examples of another beautiful sponge, commonly known as the glass-rope sponge (*Hyalonema*), and, strange to relate, it also was long represented upside-down, with its glassy rope of siliceous fibres spreading out above, instead of serving to fix the sponge to the bed of the ocean. Both of these lovely organisms, *Euplectella* and *Hyalonema*, belong to the same group of siliceous sponges, the *Hexactinellidæ*, so called because their spicules are primarily six-rayed.

Circumstances of great interest to naturalists may be observed in both *Euplectella* and *Hyalonema*. In the former, it often happens that the body-cavity contains species of curious crustaceans, and it was thought that the poor little creatures were "the insects" which produced the exquisite sponge. The presence of the crab within the body-cavity of the sponge, however, serves to illustrate a very peculiar and important occurrence in Nature, known as *commensalism*. The crab does not live *at the expense* of the sponge, and is not therefore a *parasite;* it merely lives *with* the sponge at a place best adapted to the provision of its wants. It commenced its existence within the sponge as an egg or young animal taken into the body-cavity with other food; instead of being digested, it survived, and grew there into an adult crab, living upon materials brought to it by the sponge; it received all the necessary wants of life in a comparatively secure retreat, and transmitted the peculiarities, whereby it was enabled to survive, to its offspring, fitting them to take up their abode within the same or some other *Euplectella*. Here we have an excellent example of the survival of the fittest. Now, if we look at *Hyalonema*, we shall observe in most specimens that the glassy rope is covered over with a brown incrustation. When perfectly fresh, this outer brown coating is resolvable into a number of closely adherent sea anemones of the genus *Palythoa*. To *Palythoa* the fabrication of the sponge was once attributed; but careful researches into its structural relations has shown that *Palythoa*, like Euplectella's crab, is only a commensal.

For many years Venus's flower-basket was considered to be a very rare organism, and found a place only in the cabinets of the wealthy; specimens can now be procured at from four to ten shillings each. The demand for specimens made the fishermen of the Philippines very zealous about concealing their hunting-grounds, and Professor Owen, in describing the capture of the type specimen,‡ said that it was reported to have been obtained off the island of Bohol, at a depth of ten fathoms, and on a rocky bottom. All subsequent experiences show that *Euplectella* lives only on a soft muddy bottom, at depths, according to Captain Chimmo, of from 120 to 140 fathoms.* In the voyage of the *Challenger*, numerous examples were procured off the island of Zebu, at from 95 to 100 fathoms, and only one solitary form (*Euplectella suberea*), with fragments of others, have been described by the late Sir Wyville Thomson† as coming from a depth of 1,090 fathoms in the Atlantic Ocean, ninety miles south-east of Cape St. Vincent.

* "Nesseizellen und Saamen bei See-Schwämmen," Arch. für Mik. Anat., Bd. viii., 1872.

† Vol. iii. 1841, p. 203.

‡ "Transactions of the Linnæan Society, 1857." Vol. xxii.

* "Natural History of *Euplectella aspergillum*." By William Chimmo. (London. 1878.)

† "Voyage of the *Challenger*,—The Atlantic," Vol. i., p. 133.

The American *Granite Cutters' Journal* says:—"From surveys and calculations made by Mr. J. A. Farrington, civil engineer, the famous Washington boulder, near Conway Corner, N.H., is found to measure 30 ft. in height, 46 ft. in length, 35 ft. in width, and to weigh 3,867 tons. This is the largest known isolated piece of granite in the world."

The Washington correspondent of the Cleveland *Leader* writes:—"The Washington monument is the wonder of Washington, and its beauty the admiration of both Americans and foreigners. Already over 350 ft. high, it rises from the banks of the Potomac a great white marble shaft, piercing the clouds, and backed against the blue of the sky. It is already the grandest obelisk the world has ever seen, and in the æons of the future, should the nations of the day pass away, leaving no more records of their progress than the mighty ones of the Egyptian past, it will surpass the Pyramids in the wonder of its construction. It is already higher than the Third Pyramid, and within 100 ft. of the size of the second. It is taller than St. Paul's Cathedral, and when finished it will be the highest structure in the world."

Sport and Science.—Medical science has for centuries experimented on live animals for the purpose of obtaining increased knowledge of the laws of health and disease in the human body. That often unnecessary researches of this kind have been prosecuted is probable enough; and, unfortunately, it is but too certain that many who have, perhaps, begun such researches with no other wish but to extend knowledge, have grown not merely callous but cruel. In other words, it is certain that the practice of vivisection, which is a very old practice, has been subject to abuses. Yet the legislation by which medical researches conducted on the bodies of living animals have been restricted, has not altogether commended itself to the approval of men of science. In this country most of the restrictions were not required, and were little short of insults to the medical profession. Some of the restrictions also have proved mischievous in their operation. Be this as it may, it has been shown that the Legislature can deal with the wrongs of animals when only the researches of a learned profession are in question. It is otherwise when the sports by which our idlers amuse themselves are involved. The wretched sport of pigeon-shooting, as worthy of support as the street lout's practice of flinging stones at cats and dogs, receives protection from the House of Lords Temporal and Spiritual; the latter indeed not positively voting in favour of the right of grown men to shoot at wretched half-winged pigeons, but by carefully abstaining from voting serving equally well the purpose of the wretched beings who find sport in pigeon-shooting, whether in the cruel work itself or in looking on at it.—Mr. R. A. Proctor in the *Newcastle Weekly Chronicle*.

CHEMISTRY OF THE CEREALS.

By William Jago, F.C.S.

No. V.—BREAD-MAKING (*Continued*).

IN our last paper an explanation was given of how by the action of fermentation the dough becomes charged with carbon dioxide gas. Let us be quite sure that this action is understood; certain minute organisms possess the power, under proper conditions, of effecting the decomposition of sugar into alcohol and carbon dioxide. When moist flour is exposed to air, seeds of the particular organism, which is a very low form of plant life, fall on the mass and fructify there. The flour is now changed into "leaven," and if a little be added to a further quantity of flour and water, the whole mass begins to ferment—that is to say, the growth of this plant proceeds through the whole, and sets up an active conversion of the sugar.

From the earliest times this method of causing dough to "rise" has been in common use, a portion of the one parcel of dough being set aside as leaven for the next. The coarser varieties of bread, particularly the German black bread, are still made in this fashion. For the finer varieties of bread beer-yeast is now largely used. There are two forms of this substance known in England—brewers' yeast and "German" or "dry yeast." This latter is simply brewers' yeast from which most of the water has been squeezed out, leaving a slightly moist greyish mass. Dry yeast consists almost entirely of the cells of this particular alcohol-producing plant whose action we have been studying. It has the advantage over leaven of being more concentrated and of greater purity.

In making bread with yeast, a small quantity of flour, yeast, and warm water are mixed together, and set aside in a warm place to undergo fermentation. This constitutes the "sponge"; with yeast in a healthy condition the dough is seen to rise, and bubbles of carbon dioxide from time to time escape. The sponge is next mixed with the main quantity of flour and water, and the whole mass thoroughly kneaded with the hands, and sometimes with the feet. The dough is now allowed to remain for some hours, the fermentation going on all the time; it is next cut into loaves; these go on fermenting until their size is nearly doubled; they are then baked, and still further increase in volume through the expansion of the gases under the influence of heat. The heat of the oven rapidly arrests the fermentation by killing the yeast plant.

On the continent the making of bread has attained greater perfection than in England; Paris and Vienna are justly renowned for the excellence of the bread there made. Their method of proceeding differs considerably from that in use with us. A portion of the dough from one baking is reserved for the next, and after remaining for about ten hours, is mixed with an equal quantity of freshly-made dough; this, after standing some hours, is again kneaded with a larger quantity of fresh dough, and after another interval is mixed with more dough and also some beer yeast. About half of the fermented dough is made into loaves, which, after a time are baked. The remainder is mixed with more fresh dough and yeast, allowed to ferment, again divided, the half being baked, and the rest mixed with more dough and yeast. This division and re-fermentation is altogether repeated some five or six times; the bread last produced is of the finest and whitest quality.

It will be seen that by the method of fermentation the carbon dioxide is produced at the expense of the sugar, and indirectly of the starch of the grain; the loss, however, ut a very small one, for 1 oz. of sugar yields when fermented about twelve pints, or 400 cubic inches of carbon dioxide.

With good flour the operation of baking produces but little change in the composition of the interior of the loaf: the starch will be found to have undergone but little alteration, a small proportion will have been rendered soluble, but the greater number of granules have not even had their walls broken, being simply swollen by the absorption of water. As may be imagined, the quantity of this compound present in bread is considerable; from the results of analyses of twenty-five different loaves Dr. Odling arrived at a mean of 43·43 per cent. of water. But although the "crumb" of the loaf is but little changed, there is a decided alteration in the crust. In the first place, it has a much sweeter taste, and, secondly, by proper treatment, yields a sticky substance. These characters point respectively to the conversion of starch into sugar and dextrin. These bodies may be extracted from the crust by soaking it in hot water, and then gently evaporating the clear solution. Under the influence of the greater heat to which the exterior of the loaf is exposed, the starch has suffered decomposition. When bread is "burnt," the decomposition has gone a step or steps further; provided the heat has not been too intense, the sugar is converted into "caramel." This is the material used so largely for browning gravies and other similar purposes. In composition caramel consists of a number of closely-allied substances produced by the evolution of water from the sugar in various proportions. As the intensity of the heat is increased, the sugar gets more and more changed, until at last only charcoal remains. It will be of interest here to mention the composition of a sample of good bread: After first removing as much of the water as possible, the following results were obtained:—sugar, 3·6; altered starch, 18·0; unaltered starch, 53·5; gluten, with a little starch, 20·7 per cent.

Bread when new is very different to the same article when a few days old; instead of being soft and spongy, a loaf will have become hard and almost brittle. The taste too will have altered, and that, with most peoples' palates, for the worse. The bread is usually supposed to have become dry; and certainly the cracks which score a cut surface are suggestive of a loss of moisture. On weighing the bread it will be found, though, not to have lost much; and what is far more striking, if the bread be re-baked, it again acquires the pleasant qualities of "new" bread. An experiment of re-baking stale bread showed it to have actually lost over 3 per cent. in the oven, so that, with less water, the bread had lost the peculiar dryness of taste. It is necessary, therefore, to go a step further in order to explain the change the bread has undergone in becoming stale: the water is still there, but instead of being in the free state, has gradually combined with certain of the compounds present, probably the starch. A gentle heat again decomposes these compounds, and the liberated water gives newness to the loaf.

We have so far been supposing that the flour used in bread-making is perfectly sound and of the best quality. Failing these conditions, other chemical changes occur by which the bread is more or less deteriorated. We have from time to time referred to the starch-converting power of the nitrogenous matters of grain; the bran, owing to the presence of cerealin, is particularly active in this respect. So, too, is gluten, after the flour has been exposed for some time to warmth and moisture. The change of starch to sugar by these bodies is not well understood; there, is, however, no reason to believe that it resembles fermentation by being the work of some living organism. There is some confusion on this point,

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because the older authorities class the whole series of changes together under the name of fermentation. At the risk of tautology we will again state that this term is now restricted to those changes produced by the presence of minute living organisms. Different organisms cause different kinds of fermentation—thus yeast produces alcohol, other organisms form acetic acid, lactic acid, &c. Not only does the gluten of damp flour acquire the power of converting starch, but it also frequently undergoes the peculiar fermentation productive of lactic acid. (Lactic acid is present in sour milk.) On using such flour for bread-making, the gluten attacks the starch of warm dough and produces sugar in large quantities. The result is that the bread, instead of being white, porous, and pleasant-flavoured, is dark-coloured and sodden. The sugar and acid may be recognised by the objectionable sweetish-sour taste of the bread.

Our next paper must deal with these morbid changes in bread, and methods of preventing them; particular reference will be made to the use of alum for this purpose.

FOLLY AND COURAGE AT NIAGARA*

THERE were daring men before Captain Webb, and, of course, they have found their way to Niagara. One jumped from the bridge, 192 feet, to the swirling current. For fifty feet he fell like a plummet. Then he turned over twice. At last he struck the water with an awful slap—what the boys call a "belly-whopper." After reading an account of a fatal accident, one of the numerous Mrs. Partingtons asked if the man died. So I say plainly this man died, probably before he reached the water. And yet, perhaps, that idea, too, has gone to meet the exploded legend of William Tell. But such little accidents only stimulate the reckless. Another jumper soon appeared, as soon another swimmer may. He wore a harness over his shoulders. To it was attached a wire, running loosely over a cylinder on the bridge. That kept his feet straight towards Davy Jones' locker, and he survived the leap, to his considerable personal profit. From bridge to water he went in four seconds—the only time on record. Another foolhardy feat was performed by some of the reckless men who decorate almost inaccessible landscapes with possibly truthful but most certainly inapropos puffs of ague pills, liver-pads, and such. A log once lodged forty rods above Goat Island. For four years it lay there, seemingly as beyond human reach as the North Star. It touched the pride of certain shameless and professional advertisers, who were famous for their vandalism, that such a chance should be wasted. So when the rapids were thinly frozen over they made their cautious way to the log, and soon there was a gorgeous sign fixed, twelve feet by four, a hideous eyesore, inescapable, on the very fore-front of one of the world's grandest spots, *i.e.* :—

> GO EAST VIÂ LAKE WINNIPISEOGEE R. R.

Their deed almost met its deserts. They treated the log too roughly. A hole was made through the ice and the current soon did the rest. It was even betting that they would not get ashore. But they did. This was not a fatal accident.

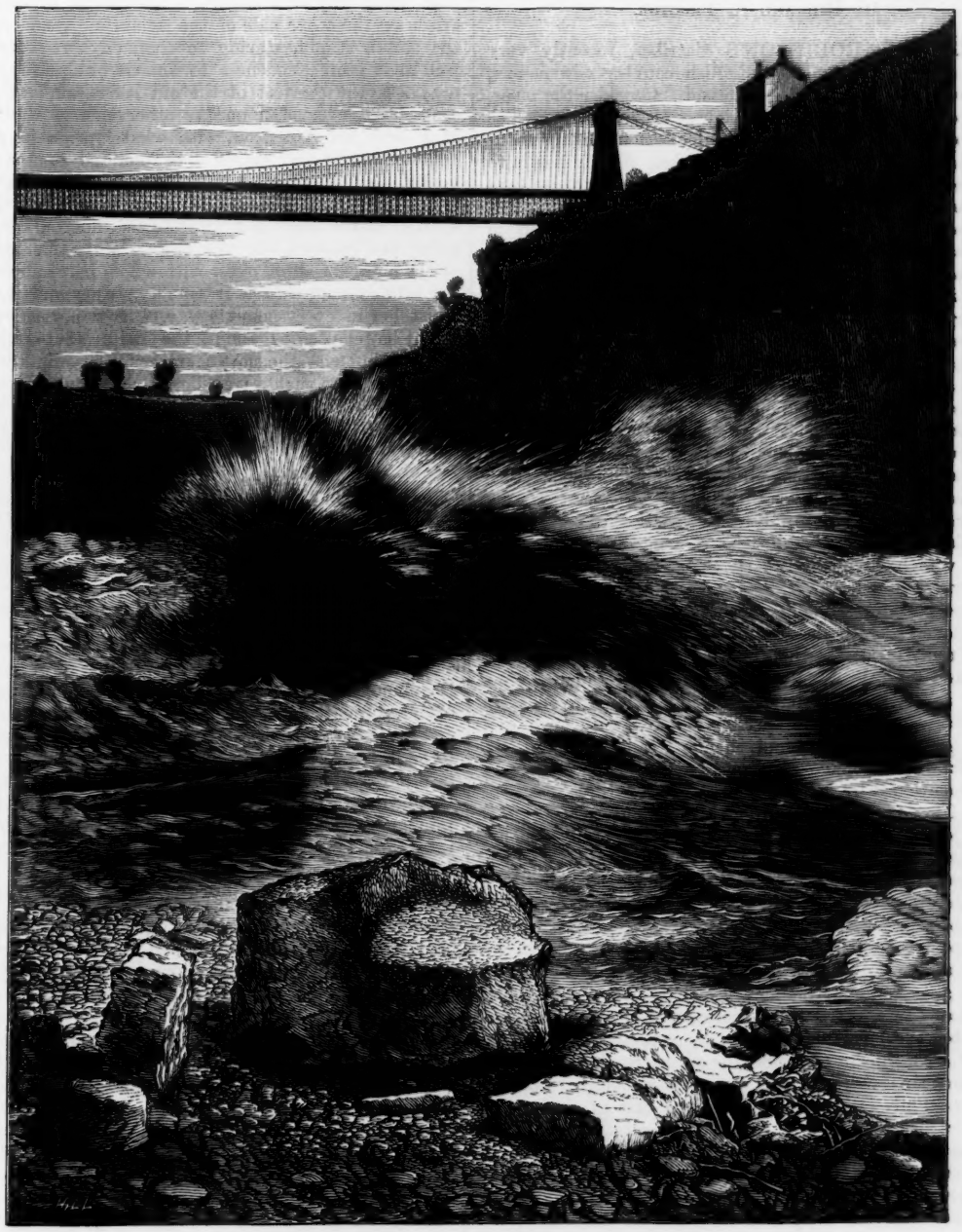
Of accidents some very strange ones are recorded. One lady stooped for a cup of water, lost her balance, and was out of reach and over the falls almost before her amazed husband knew what had happened. Another lady stooped to pluck a flower on the brink of Table Rock. She was taken up dead from the rocks below. A rhyming irreverent tourist on the same day recorded a bit of elegiac poetry that would have made him a man of mark in Philadelphia. He simply wrote :—

> "At the early age of twenty-three
> Was pitched into e-ter-ni-ty."

In 1875 an accident equally sad and foolish occurred. An engaged couple went behind the falls, into the Cave of the Winds, without a guide. The lady actually sought to bathe in a pool which even the guides never visited. Her lover lost his life in trying to save hers. Perhaps the most dramatic accident was the following: A playful young man caught up a charming child who was watching the tumbling waves. "Now, Lizzie, I am going to throw you into the water," he said, and swung her back and forth. She screamed, struggled, and slipped from his hands. He gazed after her, realised what he had done, and leaped. Rescue was hopeless. Perhaps he did not deserve death, and at least censure may die with him.

Of escapes, there are one or two narrow almost beyond belief, and which involve stories of skill and bravery well worth telling. Not many years ago a painter was at work on Second Sister's Island, when he fell into the water. He was old and weak, and while his position was not very dangerous at first, he soon floated down and toward midstream, when, just as he seemed hovering on the brink, and exactly forty feet from it, if contemporary records are to be believed, he caught on a rock. How long would his muscles endure the strain? And who would rescue him, and how? The crowd was helpless until a guide appeared with a coil of rope. One end he left in trusty hands, and with the other he plunged into the boiling tide. When he reached the poor painter the old man still held in his hand the putty-knife with which he had been working. He shifted the knife to his pocket, tied the painter to the rope, and they reached the shore safely. In another case a boatman was crossing the river above the falls, when a fog suddenly came up. He lost his bearings and knew he was drifting to death. His cries alarmed the village, and bells were rung for him to row toward them. Then an oar broke. His only hope then lay in a paltry little anchor and a common rope, which was, moreover, much worn. He examined every foot, nay, every inch of it; he tugged at the knots at each end. Time and space were precious, but he could not afford to make a mistake. Then he threw it over. It bumped along the stones, and his heart beat each time it failed to catch a grip. At last it caught, and brought the boat up standing while the tense string throbbed like the bass gut of a harp. For the moment it held. How soon would it part? He shrank from feeling along the strands. He was more afraid not to lest he should read his fate in the twine tense and twanging under the current. Inch by inch his fingers travelled to his arm's length. So long as he held there he was safe. Time and time again through the long night he did this, but never, he said, without a heart like lead and hands quivering like a leaf. When morning dawned, as at last it did, he was easily saved. In another case the danger to life, though considerable, was not imminent. A tug was towing three scows, when one went adrift. With admirable promptness and address the captain of the tug cut loose the rest of his tow and steamed ahead of the drifting barge. There he held it by steam power, and when the others came along a line was passed, the throttle was

* *New York Times'* Niagara Falls Letter.



THE WHIRLPOOL RAPIDS, NIAGARA.

(*From an Instantaneous Photograph.*)

thrown dead open, and it was sought to make way up stream. But they had drifted fairly within the grasp of the spirit of the waters, and for a time it seemed he would not let go his own. Finally a foot was gained, in a few minutes another, and then the tug of war was virtually over. An "escape" of another sort was that of a murderer. The Sheriff was behind him, the river in front, and only the wires of the old bridge at Lewiston to help him across. Hand over hand he began the passage. His hands quickly blistered, and then they bled. Again and again he rested his arms by hanging by his legs. At last he reached the opposite bank and lay panting full an hour before he continued his flight. The feat was certainly a remarkable one for an amateur.

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AMERICAN MANNERS IN TRAVELLING.

By Richard A. Proctor.

MR. PHIL ROBINSON'S diatribes, recently very widely circulated in English country newspapers, illustrate well the bias of patriotism. Consider the pleasing effects produced by this "highest of civic virtues" as thus manifested. (Some will say I am not writing about science; but in these days sociology has already begun to be a science, and it deserves to be regarded, and soon will be regarded, as among the most important of the sciences.) I do not know how long Mr. Robinson has been in America or how much he has travelled there; but even if he has been no longer there than the twenty months which, in all, I have passed in America, I should say it was very unlikely that he had travelled more than I in that country, seeing that during nearly all those twenty months I have been busily travelling from place to place, and sometimes for weeks in succession have averaged ten or twelve hours' travel per day. Let me in passing also note that so much hard travelling does not tend to encourage fair judgment of manners, &c., but rather to cause the traveller to look with jaundiced eyes on all or nearly all he sees. I may further add that to my own experience of American travelling ways, I can add those of members of my own family who have passed nearly their whole lives in that country. I find, however, that whereas Mr. Phil Robinson describes certain bad habits as characterising the travelling Americans generally, leading to the idea that at least nine out of ten Americans when travelling grab their food, and gorge and snort in ways too hideously unpleasant for repetition, I have never among all my fellow-travellers in America seen one single person afflicted with such evil habits (all at one time); and though I can cite one or two cases in which I have seen one particular bad habit of those mentioned by Mr. Robinson, two or three cases in which I have seen another, there are one or two of the evil habits which he attributes to Americans generally which I have never seen at all. Yet I am an observant traveller, very sensitive to sights and sounds and smells not altogether agreeable, and certainly ready enough to mention what I have noticed.

Supposing for a moment, though I think it utterly unlikely, that Mr. Robinson had in one single instance seen all the gross faults of manners which he attributes to all Americans when travelling—supposing (which I flatly deny, however) that some one of these faults could be seen in half, or a third, or a fourth, or even a tenth or twentieth of American travellers, still would it not have occurred to Mr. Phil Robinson, but for the bias of that "first of civic virtues," that if in England all classes had, as in America, to seek the same refreshment rooms and to sit at the same sets of tables, the observed instances of bad manners would be at least as numerous as I have imagined they might be (but deny that they are) in America? Of course, many will say that so far as comfort in travelling is concerned it matters nothing whether bad habits present themselves through a wrong system causing cultured and uncultured to be brought together, or through the prevalence of such habits. This would be a digression from the argument; but I believe the truth to be that the American system leads to a diminution of otherwise prevalent bad habits—for ninety-nine hundredths of the so-called lower class in America will *not suffer* any inferiority to be shown in their habits in the presence of those whom they regard as no otherwise better than in having more money to spend. But be this as it may, a fair, unbiassed comparison of the manners of the travelling community, class for class, or comparing the whole number of travellers, would show that—in some way or another—a marvellous superiority has arisen on the other side of the Atlantic. Such offences as the stolid, stupid, staring so common here even among well-to-do people, rudeness to women or children, carelessness as to the comfort of the old and weak, and so forth, are scarcely ever seen on the other side of the Atlantic. If I were an American, with what "pride in my port, defiance in my eye" should I be tempted to boast that a young, inexperienced, and pretty girl, poor or rich, in her teens, can travel across the length and breadth of the United States alone and unprotected, not only in perfect safety and comfort, but with the certainty that nine-tenths of the men—of all classes—with whom her journey brings her into contact, esteem it equally a duty and pleasure to assist her in every possible way. How contemptuously I might be tempted to remind the Briton that—for reasons too well known—the most courteous and well-meant proffer of assistance to such a traveller in this country is apt to be looked on with suspicion. On the Continent, and especially in France, it is even worse.—*Newcastle Weekly Chronicle.*

Insulating Wires.—A composition for insulating wires has been recently patented, which is made up as follows:—By mixing ozokerit with blacklead, carefully dried, and guttapercha in the proportions of about 3 of ozokerit to 10 parts black lead and 15 guttapercha. The properties of the constituents do not by any means augur success.

New Source of Caoutchouc.—The attention of the Indian Government has been drawn to a new plant, which is common in southern India, and yields abundant supplies of pure caoutchouc. It is an apocynaceous plant called *Prameria glandulifera*, the native habitat of which appears to be in the forests of Cochin China, where the liquid juice is often employed in medicine by the Annamites and Cambodians. When broken, the twigs are seen to contain an abundance of caoutchouc, which can be drawn out into threads, as in the East African Landolphias.—*Electrician.*

The Human Footprints in Nevada.—The scientific world was much excited during the summer of 1881 by news of the discovery of human footprints near Carson, Nevada. The tracks were uncovered in quarrying stone for building. Some of the tracks were made by an animal allied to the elephant; some resembled the footprints of the horse and the deer; others were made by a wolf; and some were bird tracks. The supposed human footprints were in six series, each with alternate right and left tracks. The stride was about that of a man of medium height, being from $2\frac{1}{2}$ to 3 feet in length. The footprints are from 18 to 20 inches long, and about 8 inches wide, and the line of the right tracks is separated from the line of the left tracks from 18 to 19 inches. This width of straddle was naturally regarded as affording strong reason for rejecting the belief that the footprints were those of men. Professor O. C. Marsh has put forward the much more probable theory that they are the tracks of a large sloth, remains of which have been found at the same level as the tracks. "The footprints," he says, "are almost exactly what these animals would make if the hind feet covered the impressions of the fore feet." In size, in stride, and in width of straddle the footprints agree closely with what would probably be made by the *Mylodon* or by the *Morotherium*, the two kinds of sloth whose remains have been discovered in the same geological strata.—*Newcastle Weekly Chronicle.*

THE COLOURED CURTAIN IN THE EYE.

By William Ackroyd.

THIS ring-like curtain in the eye, of grey, green, bluish-green, brown, and other colours, is one among the very many remarkable contrivances of the organic world. The eye cannot bear too much light entering into it, and the coloured curtain so regulates its own movements that too much light cannot enter the eye. The dark circular aperture in the centre, known as the pupil, is consequently for ever altering its size; on a bright sunshiny day, out in the open, it may be only the size of a pin's head, but at night, when there is no light stronger than starlight, it is even bigger than a pea.

This coloured ring curtain is fixed at its outer edge, and its inner edge expands or contracts so readily and, apparently, so easily, preserving its circular outline all the while, that it is quite provoking to the inventor, who has been trying to invent movable "stops" or "diaphragms" for years, and after all his labour cannot even approach it in perfection, and his despair is complete when he learns that the movements of this eye-curtain are automatic and quite independent of the will.

It is unlike the ordinary window-blind, which is generally of a rectangular shape, and is drawn up or let down according to the amount of light entering the room. The eye-curtain or iris is of ring shape, and possesses a wonderful power of expanding itself so as to diminish the area of the pupil, and of shrinking in, so as to enlarge the area of the pupil. Its movements may be watched in a variety of ways, some of which we shall describe.

The common way of watching the movements of the iris is to regard it closely in a looking-glass while the amount of light entering the eyes is varied. Place yourself before a looking-glass and with your face to the window. Probably the iris will be expanded, and there will only be a very small opening or pupil in the centre. Now shut one eye suddenly, while narrowly watching the other in the glass all the time. At the moment the light is cut off from one eye, the iris of the other contracts or is drawn up so as to enlarge the pupil. This shows that there is a remarkable interdependence between the curtains of the two eyes, as well as that they are affected by variations in the quantity of light falling on them.

Perhaps one of the most interesting ways of watching the movements of these sympathetic eye-curtains is one which may be followed while you are out walking on the street these dark winter nights. A gas-lamp seen at a distance is comparatively-speaking a point of light, with bars of light emanating from it in many directions. These bars, which give the peculiar spoked appearance to a star, are probably formed by optical defects of the lens within the eye, or by the tear-fluid on the exterior surface of the eye, or by a combination of all these causes. Be that as it may, the lengths of the spokes of light are limited by the inner margin of the eye curtain; if the curtain be drawn up, then the spokes are long; if the curtain be let down, or, in other words, if the pupil be very small and contracted, then one cannot see any spokes at all. Hence, as I look at a distant gas-light, with its radiating golden spokes, I am looking at something which will give me a sure indication of any movements of the eye-curtains. I strike a match and allow its light to fall into the eyes; the spokes of the distant gas-lamp have retreated into the point of flame as if by magic; as I take the burning match away from before my eyes, the spokes of the gas-lamp venture forth again. The experiment may be utilised to see how much light is required to move the window-curtains of the eyes. Suppose you are walking towards a couple of gas-lamps, A and B; B about fifty yards behind A. Then, if you steadfastly look at B and at the golden spokes apparently issuing from it, you may make these spokes a test of how soon the light of A will move your ires. As you gradually approach A, you come at last to a position where its light is strong enough to make the spokes of B begin to shorten; a little nearer still and they vanish altogether. I have found that about a third of the light which is competent to contract the pupil very markedly will serve to commence its movement.

Critical Points in Magnetism.—During the last meeting of the Physical Society Professor Hughes brought forward his magnetic experiments recently described by us, and one of the speakers remarked that soft iron brought to a red-hot state loses its property of being attracted by a magnet. As a matter of fact, Professor Hughes finds that this critical state is reached when iron is heated to a yellow-white, or just between white and red heat. Steel also loses its power of being magnetised when heated, and on being cooled to 100 deg. below zero, it again loses it. Nickel, again, loses its magnetic property at a comparatively low temperature—namely, that of boiling water, and Dr. Crookes has, we believe, devised a nickel cut out for electric lighting based on this curious fact.—*Engineering.*

In the six months from October 1st, 1880, to April 1st, 1881, 4,123 tires broke on sixty-five railroads in Germany, which had 21,247 miles of road—19·4 to every 100 miles of road, against 25 in 1880. The *Railroad Gazette* points out that there was one tire broken to every 124,760 miles run by a wheel. Like rails in this country, the breakages increase in cold weather. In successive months the numbers were:—October, 352; December, 435; January, 1,562; February, 775; March, 592. Below the freezing-point 1,553 breakages occurred; above it, 956.

Dynamite Struck by Lightning.—The following well-authenticated case of the firing of a dynamite magazine is of interest:—About a month ago, says the *Engineering and Mining Journal* of New York, the company operating the salt mines at Avery's, or Petit Anse, Iberia, Parish, La., received a large quantity of dynamite for blasting purposes. The same was stored in a magazine situated about four hundred yards from the works. Large trees were in close proximity. On Saturday, July 21st, a few minutes past twelve o'clock, a terrific storm burst on the island. Torrents of rain fell, and vivid flashes of lightning rent the skies. The workmen had barely left and reached the boarding-house, situated at some distance from the works, when the lightning struck the magazine, and immediately there followed an awful explosion. For a few minutes all seemed entirely paralysed. Recovering, some rushed out to ascertain the cause. It was then discovered that the whole building in which was stored the explosive compound had disappeared, and in its place was left a yawning chasm 15 or 20 ft. deep by about 100 ft. in length. The trees surrounding were prostrated and shattered. One, 2½ ft. in diameter was carried by the immense power in the blast, 200 yards from where it previously stood. Every building on the island contiguous to the mines was shaken in a terrible manner, causing every glass door and window to part with its glass. The buildings containing the mills and machinery were much damaged, preventing access to the shaft for the time being. Eight box-cars, ready to be loaded, were entirely crushed in their upper part, the running gear remaining intact.

XUM

THE HARVEST MOON.

By Richard A. Proctor.

FROM numbers of letters which have reached me within the last few weeks—to say nothing of past years—I infer that the explanations of the Harvest Moon in our books of astronomy have not proved altogether clear and convincing, or else perhaps they have not been very carefully read. In fact I have reason to believe that the moon's motions are not generally understood, or even known. I receive the most marvellous letters of inquiry respecting the moon's motions and phases,—some of them perfectly astounding in the calmness with which they demand explanations of peculiarities which have no existence in nature. One correspondent asks me why the moon is always full in the Arctic regions and never sets there, why she does not behave in the same way within the Antarctic as within the Arctic circle, and so forth. Another asks me whether there is any *other* explanation of the Harvest Moon than the effects of cold condensing the air; and so forth, till I feel disposed to lay down in despair the explanatory pen in order that I may take up that particular soft-nibbed quill with which I endeavour to impart information to those who chance not to possess it in any abnormal degree.

In my treatise on the Moon, the usual explanation of the harvest moon is given, with some details which are wanting from most accounts. Some errors also are corrected which have resulted from the careless way in which the comparatively rough statements of Ferguson have been copied and re-copied in our books on astronomy. I propose now to give an explanation which I believe to be new (at least in form). It also includes some information about the lunar movements usually overlooked.

First let it be noted that the path of the moon among the stars is somewhat like that of the sun, but inclined 5° 8′ (on the average) to his.

Thus suppose Z N Z′ S represents the celestial sphere, S O N the horizon plane for London, N being the north point, S the south, the east and west points (Orient and Occident) being both at O (the former nearer the latter farther from the eye, which is supposed to view the celestial sphere from outside). Let Z be the zenith, Z′ the nadir, P O P′ the polar axis, E O E′ the celestial equator ($\angle$ P O N = 51½° and E O S = 38½°).

Suppose the sun's path or the ecliptic represented by E O E′ inclined 23½° to E O E′. This path is of course carried round by the diurnal rotation, so that in our figure it might either be shown as a straight line or as an ellipse, according to the time of day and year. But once in each day the sun's path would have the position shown in the figure, the further half of the path passing through the west point at O and the nearer part through the east point at O.

Draw M O M′ *m* O *m*′, inclined 5° 8′ to *e* O *e*′. Then M O M′ lines would represent the moon's path as projected into a straight line at the time when the inclination to the equator E O E′ is a maximum—or about 28°; while

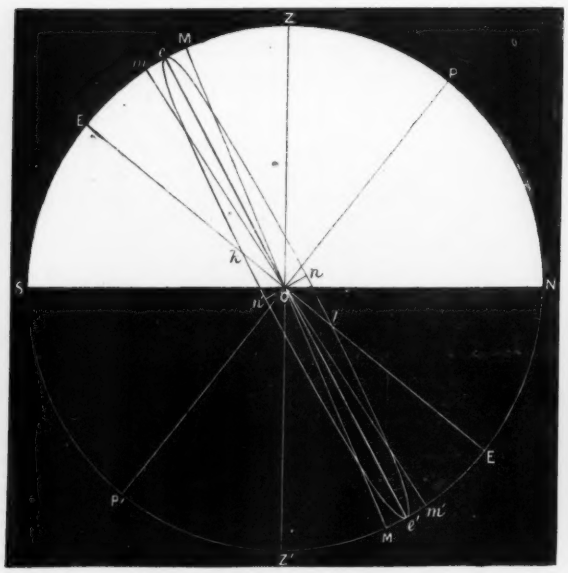


Fig. 1.

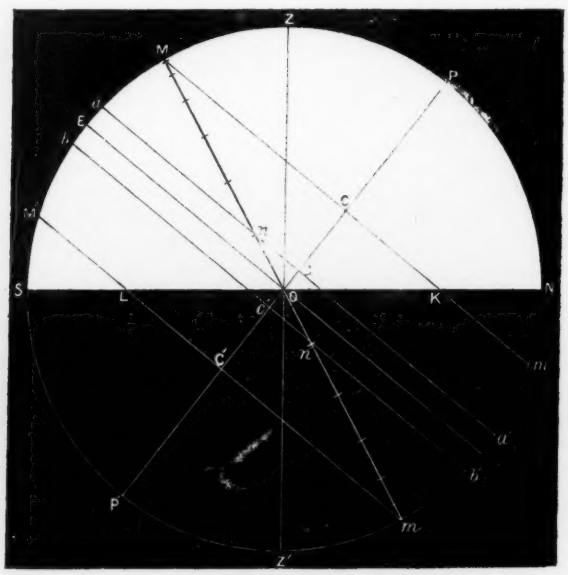


Fig. 2.

m O *m*′ would represent the moon's path projected into a straight line at the time when the inclination to the equator is a minimum, or about 18¼°. The ellipse *e n*′ *e*′ *n* (*n n*′ = M *m*) would represent the moon's path (sun's path being brought to position *e* O *e*′) at the time when the inclination has its mean value, about 23½°, *k* and *l* being the points (*l* on the nearer, *k* on the farther hemisphere) where the path at this time cuts the equator.

About 18½ years pass while the moon's path is changing from the position *m* O *m*′, to the position *e n*′ *e*′ *n*, thence to the position M O M′, and so through the position *e n*′ *e*′ *n* again, to the position *m* O *m*′.

We need not further amuse ourselves with these changes of inclination to the equator, but taking the mean inclination, as when the path is *e n*′ *e*′ *n*, consider the moon's monthly and diurnal motions,—and first without reference to changes of phase.

But it will be well to bring the celestial sphere to such a position that the path *e n*′ *e*′ *n* is projected into a straight line, manifestly in the position *e* O *e*′ which before repre-

sented the ecliptic or sun's path, only it must be remembered that the moon's path round the celestial sphere never does coincide with the sun's path, but is always inclined about 5° 8′ thereto.

Let Z N Z′ S, Fig 2, represent the celestial sphere, other letters representing the same things as before, but M O m, inclined 23½° to the equator E O E′, representing the moon's path when at about its mean inclination to the equator.

Then in each sidereal month the moon (when at her mean inclination, and neglecting slight changes which her path is always undergoing) travels once round the path M O m, passing from O in the farther hemisphere to M, thence to O in the mean hemisphere, to m, and to O in the farther hemisphere as before. When she is at O, whether on the farther or mean hemisphere E O E′, the equator represents her diurnal course, O E O (from eastern O to western O) being the above-horizon half, O E′ O (from western O to eastern O) being the below-horizon half. She takes about 1 day 50½ min. in being carried once round, her own motion the other way causing the mean lunar day to be 50½ min. longer than the mean solar day. Of course the moon's motion in a day, solar or lunar, carries her considerably away from O, so that she never does actually complete such a circuit as we have just imagined. That is the circuit she would complete if she remained the whole day on the equator E O E′. As a matter of fact if she were at O at the beginning of a diurnal circuit she would have got to n or to n' at the end of that time, by her monthly motion along her own path M O m; at n if she were passing from O on the farther hemisphere ascendingly or northwards from the equator; at n', if she were passing descendingly or southwards from the equator point O on the nearer hemisphere. Her real course would be a spiral approaching P or P′ from E O E′: but we need not specially concern ourselves with this consideration.

When, a week after being at O (on the farther hemisphere, suppose), the moon has passed to M on her own path, her diurnal course is the circle M C m', of which only the small part represented by K m' (or projected into K m') lies below the horizon. A week later she is at O again: a week later at m; and now her diurnal circuit is projected into M′C′m, of which only the part represented by M′L (or projected into M′L) is above the horizon. A week later still she is again at O. Her real diurnal path is a spiral ranging between the parallel planes M C m' and M′C′m.

I have here said a week, when strictly I should have said a quarter of a sidereal lunar month, or of the time in which the moon completes the circuit of the stellar sphere. As a lunar sidereal month lasts 27⅓ days or thereabouts, each fourth of the circuit lasts about 6⅚ days, or not quite a week.

It is to be noticed moreover that when, as indicating with such problems as the harvest moon, we consider the successive risings, southings, and settings of the moon we are dealing really with the lunar day. Lunar days vary, indeed it is their variation which has chiefly to be considered in discussing the harvest moon: but of mean lunar days, there are only about 26½ in a sidereal lunar month, and about 28½ in a lunation. In fact in the lunar month the number of lunar days is one less than the number of solar days, the moon losing one diurnal circuit per lunation as compared with the sun.

We are now in a position, knowing what are the moon's movements without reference to phase, to determine what they will be in any given month when her phase at the time she is at any point of her own orbit, is known.

(To be concluded in our next.)

Obituary.

DEATH OF PROFESSOR TOBIN.

WE learn with sorrow of the death of Professor Thomas W. Tobin, at Louisville, Ky. He will be well remembered by many in this country as a fellow-worker of Professor Pepper's at the Polytechnic; but obtained a wider and more enduring reputation in America as the inventor of the sine pendulum, and as a skilful exponent of scientific truths. He was born in January, 1844, in London, so that he was not quite forty years old when he died, on Saturday, August 4th last. He went to America twelve years ago with Professor Pepper, and resolved to stay in that country when Professor Pepper, disheartened by failure, returned to England. The Legislature of Kentucky made an appropriation of $500 for the construction of one of Tobin's sine pedulums, and Colonel Young was appointed as Commissioner to take charge of it when it was exhibited at Paris. The pendulum is now in the Agricultural and Mechanical College, Richmond, Ky. The Polytechnic Institution, Louisville, Ky., was founded chiefly through the exertions of Professor Tobin, Dr. Stuart Robinson, and Colonel Bennet H. Young. Professor Tobin was appointed scientific lecturer there, and held that position till the time of his death. Crowded audiences attested his skill in the art (more difficult than is generally thought) of so interpreting science as to interest the unscientific. Professor Tobin was a genial man, of companionable manners, wide-reading, and cultured tastes. He died of consumption, a disease to which his mother and all his brothers and sisters had already succumbed.

A CABLE FOR COCHIN-CHINA.—The recent operations of the French in Tonquin have directed public attention to that part of the globe; but it is not generally known that the Eastern Extension Telegraph Company have for some time past made arrangements for laying a submarine cable between Tonquin and Cochin-China. It was intended to lay the cable from Saigon, where communication already exists, and Hai-Phong with a branch into Hanoi. Unfortunately, however, the French Chamber has rejected the proposals of the English company in favour of a less advantageous offer by M. Blanscube, deputy of Cochin-China. The Colonial Council of that possession have proposed to share the expense of constructing the new line, which there is every reason to believe will be made by French manufacturers and laid in French territory.—*Engineering.*

A MEETING of the subscribers to the parliamentary fund of the Manchester Ship Canal was held on Tuesday week at Manchester. It was reported that the committee had received from subscribers £46,778, and that the expenditure amounted to £47,510. The committee were of opinion that another application to Parliament would be successful. A motion was passed expressing regret at the action of the Committee of the House of Lords in stopping the Bill. The provisional committee was empowered to promote the Bill in the ensuing session of Parliament, in such manner as might be found expedient or desirable. It was stated that promises of £5,000 had been received towards the cost of the second application to Parliament.

LETTERS from Athens, says a contemporary, announce an interesting discovery, brought to light in the course of some excavations which are being carried out in the Island of Delos by the pupils of the French School at Athens. In the neighbourhood of the Theatre of Apollo, they came upon the remains of a private house, which apparently belonged to the Alexandrine epoch. A court surrounded by pillars and twelve chambers has been opened out. The floor is composed of mosaic, which is a fine specimen, representing flowers, fishes, and other ornaments. In the middle of the court is a well, now quite choked up. The door of the house, and the line of roadway or street leading to it, have also been discovered. The excavations will be continued, and it is hoped that a large portion of the old town will be brought to light.

XUM

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

[915]—With reference to the solution of the problem which appeared in your issue, No. 95, of the 24th inst., as to the height of Galley-Head Light, you have, it appears, assumed the distance to be twenty-one statute miles.

I think it probable that Prof. Tyndall meant twenty-one *nautical* miles, which would, allowing for the mean refractive effect of the atmosphere, make the height of the light about 205 feet.

The light is, as you say, known not to be as high as this, but most likely the data are not very correct. Hundredweight.

[I cannot see why Prof. Tyndall should be assumed to have meant geographical miles. Most probably he really estimated the distance from the known height of the light. The flat-earth men think any stick good enough to beat anyone with who talks of the sea's rotundity.—R. P.]

PUNCTUATION AND PRINTERS.

[916]—Sir Edmund Beckett's article on this subject is hardly likely to make converts either to his style or his mode of punctuation. Here is a phrase which I read several times before I could grasp either its sense or its grammar—"and when he sees that he ought to leave us alone to bear our own iniquities if we let our proofs go 'unpeppered' more than he thinks right." A comma after the word "that," which the punctual punctuator neglects to supply, would have made his meaning clear. Now, as to style, what about the following sentence?—"and thereby would raise the indignation of every architect in England into a still hotter flame *than it is in just now I see*, at my having dared," &c. And again:—"If anybody doubts your opinion of Macaulay's style, which was always mine [not the style, surely?], let him try it by the test of reading it [reading what? the opinion or the style?] aloud, against Froude's," &c. Sir E. Beckett's letter confirms me in my opinion that one can punctuate another man's work better than one's own. F. R.

["F. R." should remember that Sir E. Beckett's communication came as a letter, not as an article, and that he had no opportunity to correct the proof. The context showed the true meaning of the words "when he sees that"; no one could suppose that *that* that (that that that that that "F. R." says refers to) was meant for a conjunction. I have noticed in Sir Edmund Beckett's style that it usually takes for granted a certain degree of attention on the reader's part to the subject-matter. Granted this, no one can ever mistake his meaning,—though one may readily show that, where what he has said and what he is saying is not attended to, a sentence here or there may admit of more than one interpretation. Perhaps it is not unfair to assume that a reader pays a little attention to what he is reading. So much attention as would prevent any one from misinterpreting Sir E. Beckett is not a distraction—like attention called away by over-stopping, &c.—but tends the other way.—R. P.]

SMALL WHEELS *v.* LARGE WHEELS.

[917]—Mr. Browning's remarks advocating the use of small geared-up wheels for tricycles are sound, and will not be without their effect. But I have lately found out that (contrary to what he supposes) they may also be used for bicycles, with the additional result of making them so safe that they would certainly be brought into successful competition with tricycles on the question of safety.

I have recently invested in a bicycle with "Sun and Planet" action—a small machine, geared up in the most ingenious way, which cannot add anything appreciable to the friction. (It was at the Stanley show, but little display was made of it.) Though simple, it defies explanation without a diagram, and should be seen *in action* to understand it; but the chief point is that the very friction of the pedals on their axles is utilised to increase the speed, and has the effect of gearing-up the wheel from 40 in. to 50 in. The pedals hang down so that a tall man can ride it.

Now, if a yet smaller wheel (say 36 in.) were used, the rider's feet could touch the ground when he stopped, and it could be geared-up to 46 in. to 50 in. With such a bicycle there could be no real danger, the advantages of handiness, lightness, and speed would be retained, and no doubt many would ride who would not think of doing so now. S. J.

REDUCING FAT.

[918]—What is the use of you devoting so much of your valuable space to the service of fat people. I am quite sure there are not *two* "gross fat men" among your many thousands of readers.

I can prove it, and that easily. Fat men are mostly stupid. Stupid men don't read Knowledge, therefore none of your subscribers are fat, and if you have *no fat subscribers* what is the use of your otherwise useful contributor wasting his energies in this hot weather by seeking to reduce adipose tissue that does not exist. He surely does not aim at reducing fatness in the abstract. I think it has been decided that it is impossible to imagine a fat man in the abstract, and I should like to know how you can administer a towelling to such an individual.

But what has most annoyed me is your contributor's last article with its remarks on this said towelling. I am as thin as a rake, and for many years I have taken sponge and towel exercise such as he describes, in the belief that it tended to increase of flesh. Now, your contributor comes along and tells me in effect that I have been rubbing it off. Must I, if I wish to accumulate flesh and make the acute angles of my anatomy more circular, to put it scientifically, leave off rubbing and scrubbing? W. S.

[The author of "How to Get Strong" was moved to write those particular papers by the appeal of several "heavy weights." He tells me (is it not impolite?) that he had "Our Editor" also in his eye. But many of the rules for reducing fat are excellent also, he tells me, for adding flesh. Therefore your towelling is probably good for you as well as for us fat fellows.—R. P.]

DIFFERENT DEGREES OF ILLUMINATION.

[919]—Some remarks towards the close of the article on the "Laws of Brightness," in last week's issue of Knowledge, induce me to offer you an artist's experience and reflections upon the subject. One of the undertakings I have ventured upon is that of substituting a science of art for the jargon which passes current. In the course of my studies to this end, the fact that the colour and the chiaroscuro of a picture never have precisely the same values the artist intended, in any but the light in which the work was executed, set me thinking, and this was the form of my conclusion, that *the ratios of the different reflecting powers of objects vary under different degrees of illumination*; and the following was the mode in which I attempted to illustrate the change effected. Take any series of numbers, for instance, 2, 4, 8, 16, then, either the addition to, or the subtraction of the same number from each term of the series, yields two other series in which the ratios of the several terms to each other are entirly altered. W. Cave Thomas.

COLOURS OF FLOWERS.

[920]—Mr. Slack, in his "Pleasant Hours with the Microscope," has given us in Knowledge a short but interesting account of the hairs of plants; how they perform the function of feeders or digestive organs by absorbing ammonia and carbon from the air. Plants also, I suppose, absorb silex and other primordial atoms from the soil. Can Knowledge, with the aid of botany, chemistry, and microscopy combined, assist us to understand how *colour* is formed in *flowers*. Colouring matter *from* plants is a well-known province of chemistry, but how are the varied colours which delight the eye and decorate the garden given *to* flowers? Is this capable of analysis or ratiocination? Lucretius (Book ii.) thought all elementary atoms colourless; Pliny (Book xxi.) that Nature, in sport, had bestowed the tints which man could not describe. Is this one of the mysteries wherein Nature laughs at the inquisitiveness of man?—Your obedient, G. G. Hardingham.

SUNSET ON THE MOON.

[921]—Watching the moon to-night, I was trying to imagine what sort of event sunset would be if one could get over the little difficulty of reaching our satellite, and be independent of such slight details as respiration, extremes of heat and cold, &c. I was getting along splendidly with the intensely black sky, the myriads of stars shining day and night, the enormous disc of the earth constantly in almost one direction, part of it bright with reflected sunlight, part just relieved from darkness by a faint reflection of moonshine, and the shading from light to dark by the refraction of our atmosphere. I supposed the sun's disc to have reached the horizon, and (roughly) in about an hour of terrestrial time his last fierce ray suddenly to fade, leaving not a suggestion of twilight to show he had been there. But here I was stopped. *Would* he disappear in this way? Of course not. Every solar appendage that can be seen from the earth during a total eclipse would be always visible from the moon. Consequently, when the disc (such as we see it from the earth) had passed below the horizon, there would still remain a gorgeous sight for our adventurous traveller [please do not call him a lunatic].

Now, this is my point. Between the part of the moon which is in darkness and the part which is fully illuminated there must be a strip which is still receiving light from the parts of the sun that lie beyond the disc visible to us. Is it possible to separate and examine the light reflected to us by that strip of the moon's surface, and so to add to our knowledge of its source? Probably the idea is already familiar to you, and its feasibility may have already been tested. Be this as it may, if I have furnished you with a text for some future article in KNOWLEDGE, I know I shall receive a hearty, though silent, vote of thanks from its readers. [I likewise bows.—R. P.] W.

FIGURE-CONJURING.

[922]—Referring to recent communications which have appeared in KNOWLEDGE, under the head of "Figure-Conjuring," I should now like to give an experiment, abridged from Professor Hoffmann's book on "Modern Magic," which I think will give completeness to the experiments above alluded to.

The performer asks one of the company to take two dice and shake them secretly in his hands; he must then turn them down on the table, shading them with his arm from all eyes but his own, and must then write down privately on a piece of paper, the numbers turned up, placing the same apart from each other. The performer then tells him to multiply the left-hand number by 2, then add 5, then multiply by 5, and then add the right-hand figure. He then tells the performer the total thus obtained, and the performer after mentally deducting 25 from the same, announces what two numbers were turned up by the dice. Thus, supposing one die showed 4 and the other 5, then the experiment would proceed thus:—

	4——5——
×	2
	8
+	5
	13
×	5
	65
Add right-hand figure	5
	70
Deduction mentally by performer	25
Leaving	4.5. the figures turned up.

Now, if the figure-conjuror would show off this experiment in the first place, then follow it up by the one given by myself (858), and, in case of difficulty with some extra-sharp victim, cap the list by going through the one given by Mr. Proctor on page 26, I think he would then astonish his audience as much as if he had gone through a clever performance with the cups and balls. I cannot close this communication without thanking our indefatigable editor for the article above referred to; I consider it quite a valuable addition to the literature of the subject. To descend from the stars to the constructing of an article on Figure-Conjuring may appear to some persons a somewhat incongruous proceeding. I, however, am quite of a contrary opinion to this. To the truly great and fully-developed mind nothing is too great and nothing too small. The wonders revealed by the microscope are quite as astonishing and mysterious as those revealed by the astronomer's tube. In truth, to the scientific eye, "great" and "small" are synonymous. G. M.

GREATEST CONTENT OF A PARCEL WHICH CAN BE SENT BY POST.

[923]—The problem on this subject, which you have solved on p. 76 by the Differential Calculus, can be solved without it, as follows:—

First.—Suppose the parcel to be a parallelopiped. Since the sum of the length and girth is 6 ft., the sum of half the length, the breadth, and the thickness, or the three dimensions of half the parcel is 3 ft. It is plain that the bulk of half the parcel will be greatest when these dimensions are equal, each 1 ft. Therefore the content of the whole parcel is greatest when it is 2 by 1 by 1 = 2 ft.

Second.—Suppose the parcel to be a cylinder. As the bulk of a cylinder has a constant ratio (that of 4 to π) to the bulk of a parallelopiped of the same length and girth, the maximum cylindrical parcel must have the same length and girth as the maximum parallelopiped, that is, its length must be 2 ft., its girth 4 ft., its bulk $\frac{8}{\pi}$ t. ALGERNON BRAY.

[The problem was given as an illustration of the application of the differential calculus to simple questions.—R. P.]

LETTERS RECEIVED, AND SHORT ANSWERS.

JAS. M. RODGER. A "flat upon a circle" may, for aught I know, be $\frac{1}{360}$th of the circle itself. I do not happen to know what a flat on a circle is.—ALG. BRAY. Latest letter on flight of missile correct, but no space for so long an investigation. Thanks for other letters.—THOS. SAYER. Will shortly put the list of Nos. in which articles on "How to Get Strong" have appeared at head of one of the forthcoming articles.—HARVEST MOON. There *are* "other causes than cold condensing moisture in the atmosphere to produce what is known to us as the harvest moon."—E. C. H. Thanks. Highest tide about three tides after full moon.—B. J. JENKINS. Thanks for correction. Reasoning in other letter scarcely convincing.—JAS. CRAM. Squares causing so much anxiety that I shudder at the thought of magic cubes.—W. S. Why should that meteor not belong to our system? Meteors often behave so.—FRANCIS H. Have as yet had no opportunities to examine the system.—G. G. H. Fear no space for numismatics, though the subject is, no doubt, interesting.—A. M. COBBOLD. The subject of spelling reform—and especially of ways in which practical attempts might be made to introduce it—is too wide for these columns.—H. H. Map of the Moon accompanied first of "F.R.A.S.'s" interesting papers. I have not vol. iii. by me for reference; know the map is in that vol.—J. S. The angle cannot be trisected by simple geometry; for the equations corresponding to the geometrical requirements is a cube. I am obliged to you for your kind expression of sympathy, though your "pleasure on hearing of my gradual recovery" might be misinterpreted.—W. WILSON. You are right in thinking that the Southern Cross affords a perfect proof of the earth's rotundity. Yet not quite as you present it; for you write as if the Southern Cross were a Polar constellation; and you overlook the difference in rotation-time at which, in the opposite directions indicated by you, the Cross is visible. An earth-flattener of the foolish sort would find a ready answer to the argument derived from mere difference of direction in the journeys taken towards the ice-barrier. But you mistake in supposing the Pretty Proofs part of a discussion with the earth-flatteners. They are so few that such a discussion would be waste time. Proofs of the earth's rotundity are interesting to those who know perfectly well that the earth is rotund. The existence of a Southern Celestial Pole round which as uniformly as round the Northern pole the stars revolve in parallel circles, is an absolute proof of the absurdity of the flat earth theory for all who have brains; but it is not sufficient for the flat earth men.—G. JORDAN. The Lunar Theory about which the Astronomical Society was talking is not what you mean by the Lunar Theory. The subject of the lunar acceleration is in no way connected with the elementary phenomena of the moon's movements. You are in deeper water than you think. I do not associate you with Hampden & Co. As to them I mention their ignorance and folly, only because of their violence and rudeness.—A WOULD-BE OBSERVER. Cannot do that.—M. H. B. Knowing nothing can say no more.—F. LETTRINGTON. Question outside our scope.—NIGEL DOBLE. Such a telescope would be almost worthless.—R. JONES. The answer relating to Text-book matter did not relate to the trisection of an angle. Cannot remember answering any question recently on this subject. Possibly some answer to another correspondent has misled you. I remember only that the question related to text-book matters, which would have occupied many pages of explanation

[Have just found your trisection question among unanswered and unopened correspondence. The trisection is perfectly sound, and if the secant could be drawn, by line and circle, to fulfil the conditions named, any angle could be trisected by line and circle. Unfortunately it cannot.—E. H. M. S. Would be glad to hear of a good book on the chemical constituents of garden vegetables.—Lutetia Rediviva. An odd coincidence. But the history of the discovery of Uranus is well-known. Sir W. Herschel himself fully recorded it, and there is nothing in the slightest degree confirming Paris's statement.—E. S. Thanks; the idea is a good one. A series of pictures of the old constellation figures, with stars, names, and explanations of these, would probably interest many. Will try to arrange the matter.—A. Holdsworth. A telescope will not reveal the hull under those conditions.—Information. Pitman's I should say. Other questions belong to a kind we have been obliged to leave unanswered.—H. J. W. Mars has two satellites, both very small,—probably not more than fifteen miles in diameter. There is an essay on them in my "Poetry of Astronomy," entitled "Living in Dread and Terror," these being the Englished names of the two satellites of Mars (Demos and Phobos).—F. R. The "cold spells" are purposely omitted by smoothing off the temperature curves.—An Inquirer. The institution of Infant Baptism is a little outside our line.—T. H. K. The weight lifted is not great,—each raised less than 3 stone, each forefinger raised less than 1½ stone. The inspiration, expiration, &c., only help I imagine by directing attention to the proper amount of lifting; so that all act together. But really lifting 40 lb. with the two forefingers is hardly a feat requiring special preparation or special explanation when accomplished.—E. T. L. Solution correct.

MATHEMATICS.

Prop.—A B, D C *are equal chords to the circle* A B C D, *meeting in* F; *and tangents* F P, F Q *are drawn, and* F b O a *through the centre* O. *Show that chords* B D, A C *intersect at* P Q.

It is clear from symmetry that G, their point of intersection, lies in *a* F; and it will suffice to show that a perpendicular chord P G Q cuts the circle in the points P, Q, where tangents from F meet it. Join O B; then in the triangles O G B, D G F, angle O G B = opp. angle D G F; and ∠ G O B (being angle at centre on B *b*) = angle at circumference at B C = angle B D F. Hence, the triangles are similar, and

O G : G B :: G D : G F

∴ O G, G F = G B, G D = sq. on P G

Wherefore, O P G is a right angle, and F P, F Q are tangents. Q.E.D.

Cor.—*If* F *be an external point from which tangents* F P, F Q *are drawn to a circle, and* P Q *cut* F O *at* G, *then straight lines* F B, F D *to the extremities of any chord* B D G *through* G *are equally inclined to* F O.

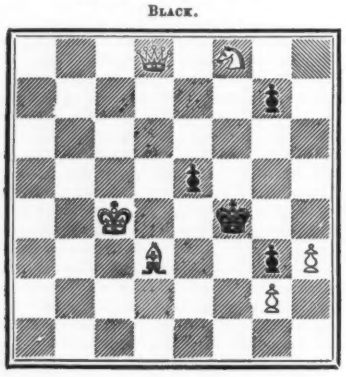
Our Chess Column.

By Mephisto.

PROBLEM No. 96.

By J. Berger Graz.

Black.



White.

White to play and mate in three moves.

FRENCH DEFENCE.

White. Herr Berger.	Black. Herr Boduschka.	White. Herr Berger.	Black. Herr Boduschka.
1. P to K4	P to K3	14. Q takes B	R to B sq
2. P to Q4	P to Q4	15. QR to Q sq	P to B3
3. QKt to B3	KKt to B3	16. R to Q3	Kt to Kt3
4. B to Q3	P takes P (*a*)	17. P to KR4	Kt to K2
5. Kt takes P	B to K2	18. P to R5	K to R sq (*c*)
6. KKt to B3	Castles	19. P to R6	Kt to B4
7. Castles	QKt to Q2	20. P to Kt4	Kt takes RP
8. R to K sq	R to K sq	21. P to Kt5	B takes P
9. QB to KB4	Kt to B sq (*b*)	22. Kt takes B	P to KB4 (*d*)
10. B to K5	P to QKt3	23. Q to R4	K to Kt sq
11. Q to K2	B to Kt2	24. R to Kt3	R to K2
12. Kt tks Kt (ch)	B takes Kt	25. Q takes Kt	P takes Q
13. B to K4	QB takes B	26. Kt tks KP (ch)	Resigns (*e*)

NOTES BY HERR BERGER.

(*a*) P to B4 is the right move here.

(*b*) If Kt to R4 then follows 10. B to K5 in reply. If then Black plays P to KB3, White could answer with KKt to Kt5!

(*c*) This is a lost move, and strengthens White's attack.

(*d*) If Q takes Kt, White will either win a piece or the Q by R to Kt3.

(*e*) After the exchange of pieces White will remain with a R ahead, *i.e.*, K to B2. 27. Kt takes Q (ch), R takes Kt. 28. R to Kt7 (ch), K to B sq. 29. R takes R, K takes R. 30. B to B7 (ch), and wins.

SOLUTION.

Problem No. 93, by L. P. Rees, p. 128—1. Kt to B3, and mates accordingly.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Berrow.—If in Problem No. 90, 1. Kt to Kt7, P takes Kt, then 2. R takes P (ch), K to K3, 3. Kt to Q8 mate.

H. Seward.—There is no penalty if a player announces mate and fails to give it.

Correct solutions received:—Problem 93, Hammond, John Watkins; Problem No. 95, Clarence, M. T. Hooton, H. Seward, Berrow, L. F. Q., End-game, Clarence.

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